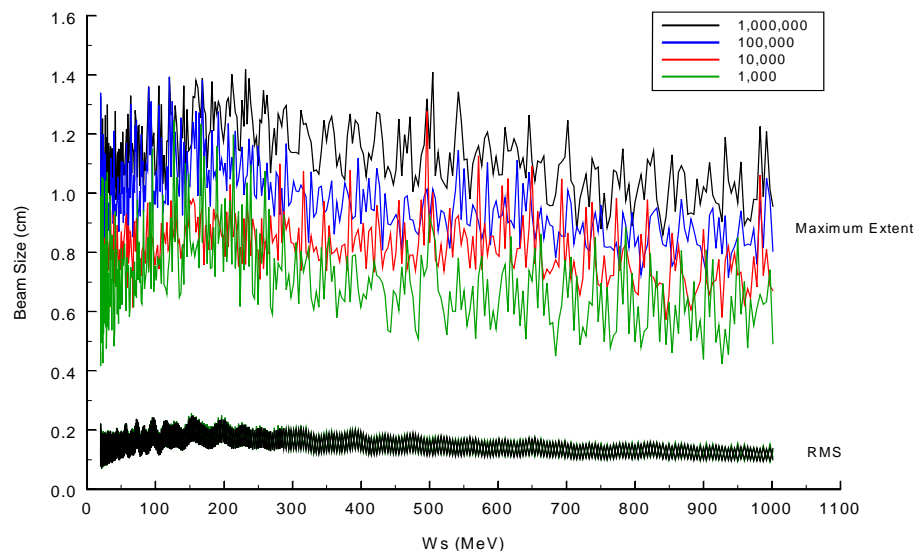


Why do we need large-scale beam dynamics simulation?

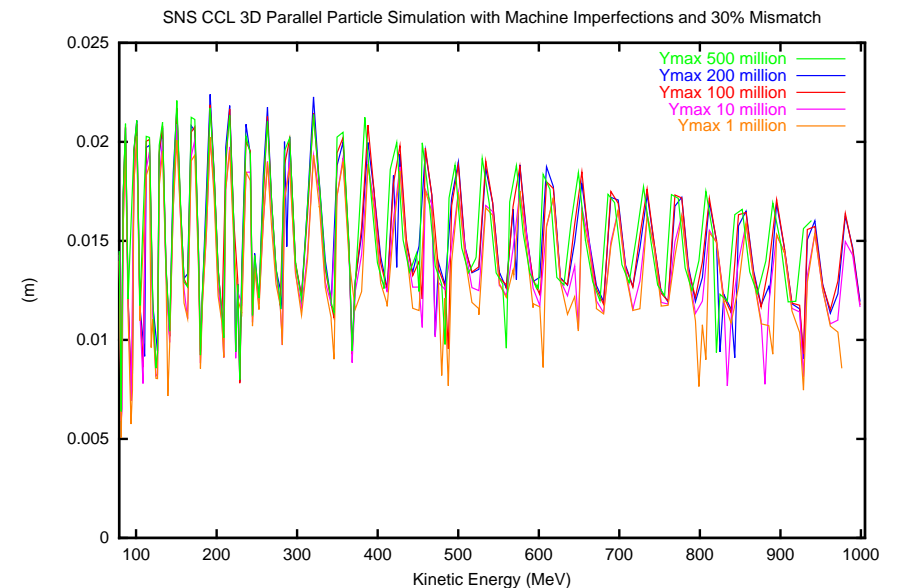
- Important applications involving high-intensity beams
 - Spallation Neutron Source
 - ν -factory/ μ -collider driver
 - Accelerator transmutation of waste, tritium production
- Ultra-low loss required to prevent radioactivation
 - beam halo a key issue
- Large-scale simulation essential for design decisions & feasibility studies:
 - evaluate/reduce risk, reduce cost
 - optimize performance

Maximum Beam Size Does not Converge in Small-Scale Simulations

Maximum beam size does not
converge in small-scale PC
simulation (up to 1M particles)



Maximum beam size does converge
in large-scale parallel simulation
beyond ~100M particles



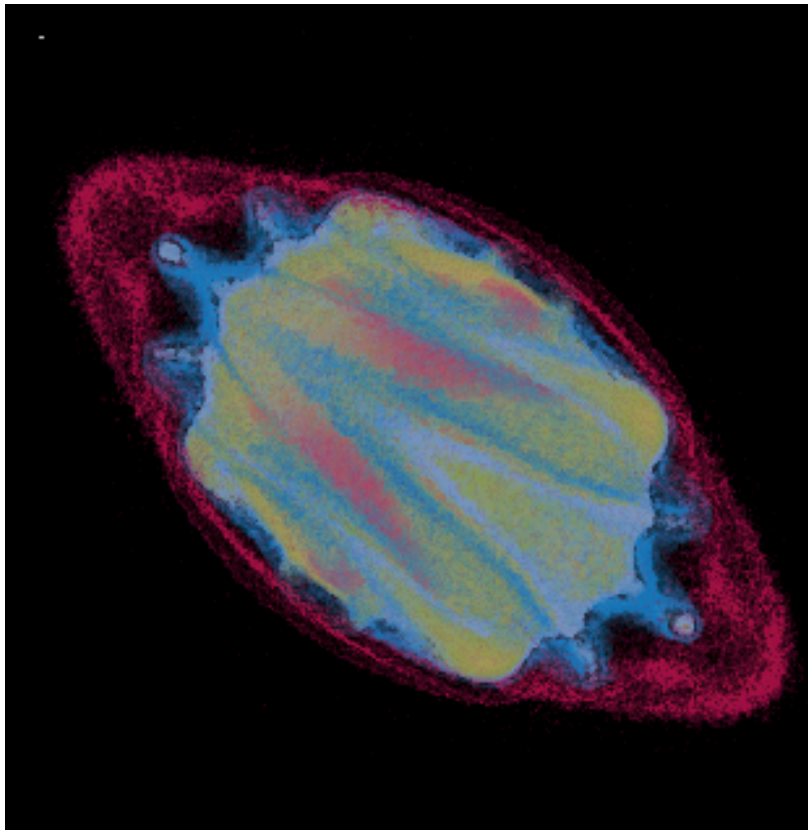
IMPACT code enables 100x larger simulations to be performed in 1/10 the time

- Model of SNS linac used 400 accelerating structures
- Simulations run w/ up to 800M particles on a 512^3 grid
- Approaching **real-world** # of particles (900M for SNS)
- 100M particle runs now ***routine*** (5-10 hrs on 256 PEs)
- Analogous 1M particle simulation using legacy 2D code on a PC requires weekend

3 order-of-magnitude increase in simulation capability

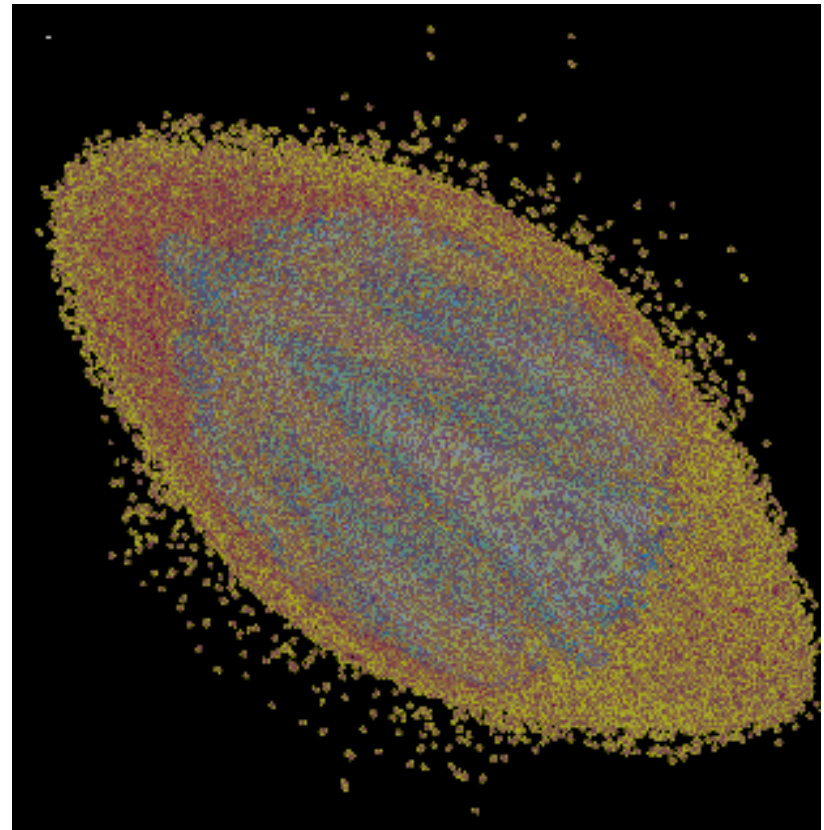
Volume Rendering of SNS Results

Transparency to see inside volume



$x-p_x$ - z space

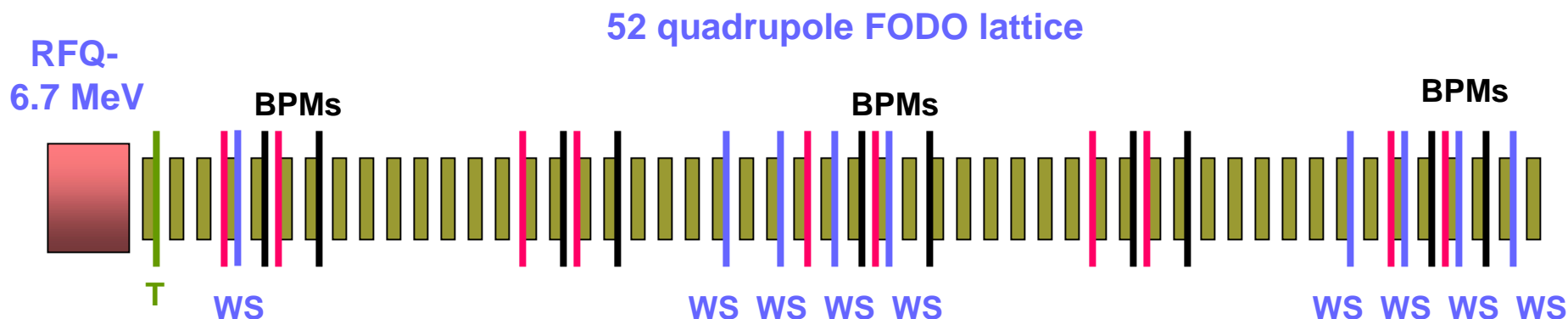
Opacity to accentuate halo



$x-p_x$ - z space

LEDA Beam Halo Experiment/Goals

- Evaluate/Assess (“Validate”):
 - computer models (IMPACT, LINAC)
 - physical models
 - particle-core model, Vlasov-Poisson model



Cumulative density profiles from 100M particle simulation of LEDA halo experiment

